Aerobic methane emission from grey poplar (*Populus* x *canescens*)

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www.biogeosciences.net/bg/1/123/
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Biogeosciences

Carbon isotope anomaly in the major plant C_1 pool and its global biogeochemical implications

F. Keppler[1,2], R. M. Kalin[2], D. B. Harper[1], W. C. McRoberts[1,3], and J. T. G. Hamilton[1,3]

Plant common name (*species*)	Chloromethane (CM) ($\delta^{13}C$)	Biomass (B) ($\delta^{13}C$)	Pectin methoxyl (PM) ($\delta^{13}C$)
C_3-leaf[2]			
European ash (*Fraxinus excelsior*)		−27.9±0.2	−73.7±1.0
40°C	−147.0		
50°C	−142.6		
60°C	−129.0		
Wych elm (*Ulmus glabra*)		−30.8±0.1	−69.2±0.3
40°C	−138.9		
50°C	−130.4		
60°C	−126.9		
Cocksfoot (*Dactylis glomerata*)		−29.3±0.2	−50.7±0.2
40°C	−119.2		
50°C	−113.5		
60°C	−110.3		

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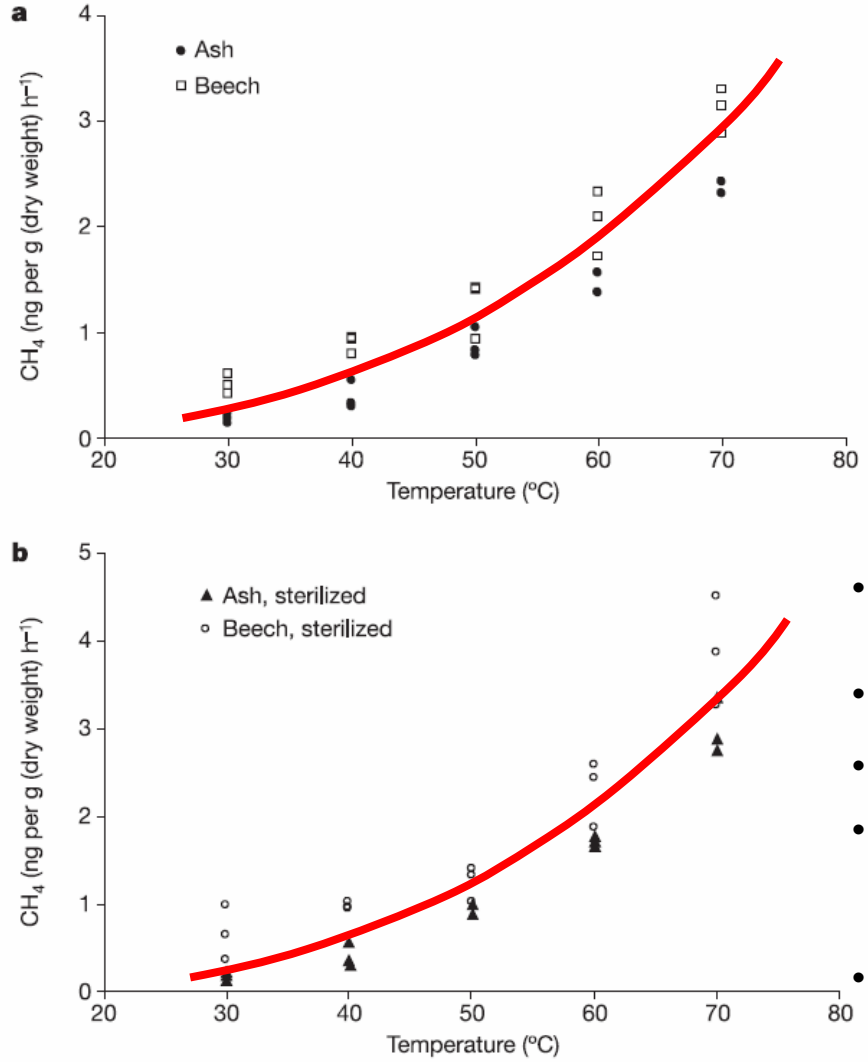
Methane emissions from terrestrial plants under aerobic conditions

Frank Keppler[1], John T. G. Hamilton[2], Marc Braß[1,3] & Thomas Röckmann[1,3]



- CH_4 emission from intact plant material 1–2 orders of magnitude higher than from detached plant material
- CH_4 emission in sun light 3-5 times higher than in dark
- CH_4 unusually depleted in ^{13}C
- CH_4 source strength of 62–236 Tg yr^{-1} for living plants and 1–7 Tg yr^{-1} for plant litter, i.e. 10–30% of the global annual CH_4 emissions
- However, most measurements performed in CH_4-free air

Reactions of the international research community

www.publish.csiro.au/journals/fpb *Functional Plant Biology*, 2006, 33, 613–615

***Rapid communication*:**

A comment on scaling methane emissions from vegetation and grazing ruminants in New Zealand

www.publish.csiro.au/journals/fpb *Functional Plant Biology*, 2006, 33, 521–530

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Rapid report

Miko U
Graham

No evidence for substantial aerobic methane emission by terrestrial plants: a ^{13}C-labelling approach

New Phytologist (2007) 175: 29–35

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Global Change Biology (2008) 14, 1821–1826, doi: 10.1111/j.1365-2486.2008.01607.x

Missing methane emissions from leaves of terrestrial plants

DAVID J. BEERLING*, TOM GARDINER†, GRAHAM LEGGETT†, ANDY MCLEOD‡ and W. PAUL QUICK*

Methodology of follow-up experiments

Dueck et al. (2007)

- basil, sage, wheat, maize grown under $^{13}CO_2$ atmosphere from seeds
- potential $^{13}CH_4$ emission measured with photoacoustic instrument
- observed no significant methane emission

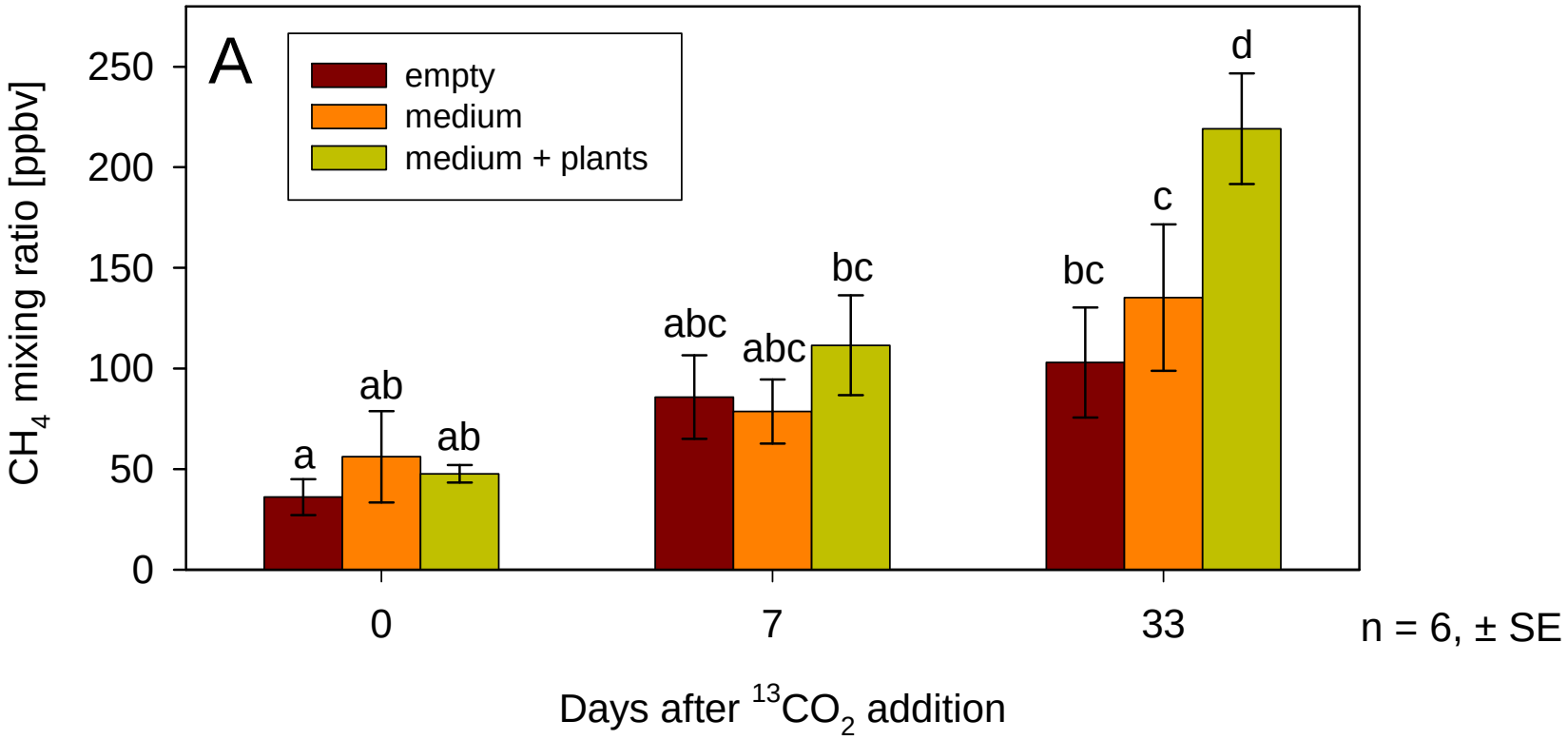
Beerling et al. (2008)

- maize and tobacco, grown under normal CO_2 in a greenhouse
- potential $^{13}CH_4$ emission measured with FID and leaf cuvettes
- observed no significant methane emission

Our experimental design

- Plant species: grey poplar (Populus x canescens, syn. Populus tremula x P. alba), derived from cell cultures under sterile conditions
- Plants on sterile medium in gas-tight flasks in CH_4-free air
- Headspace was exchanged with synthetic air containing 20% of oxygen and 385 ppm $^{13}CO_2$ (99 at% ^{13}C)
- Flasks were kept in glove box filled with pure N_2 for 33 days under a 16/8 h light/dark regime

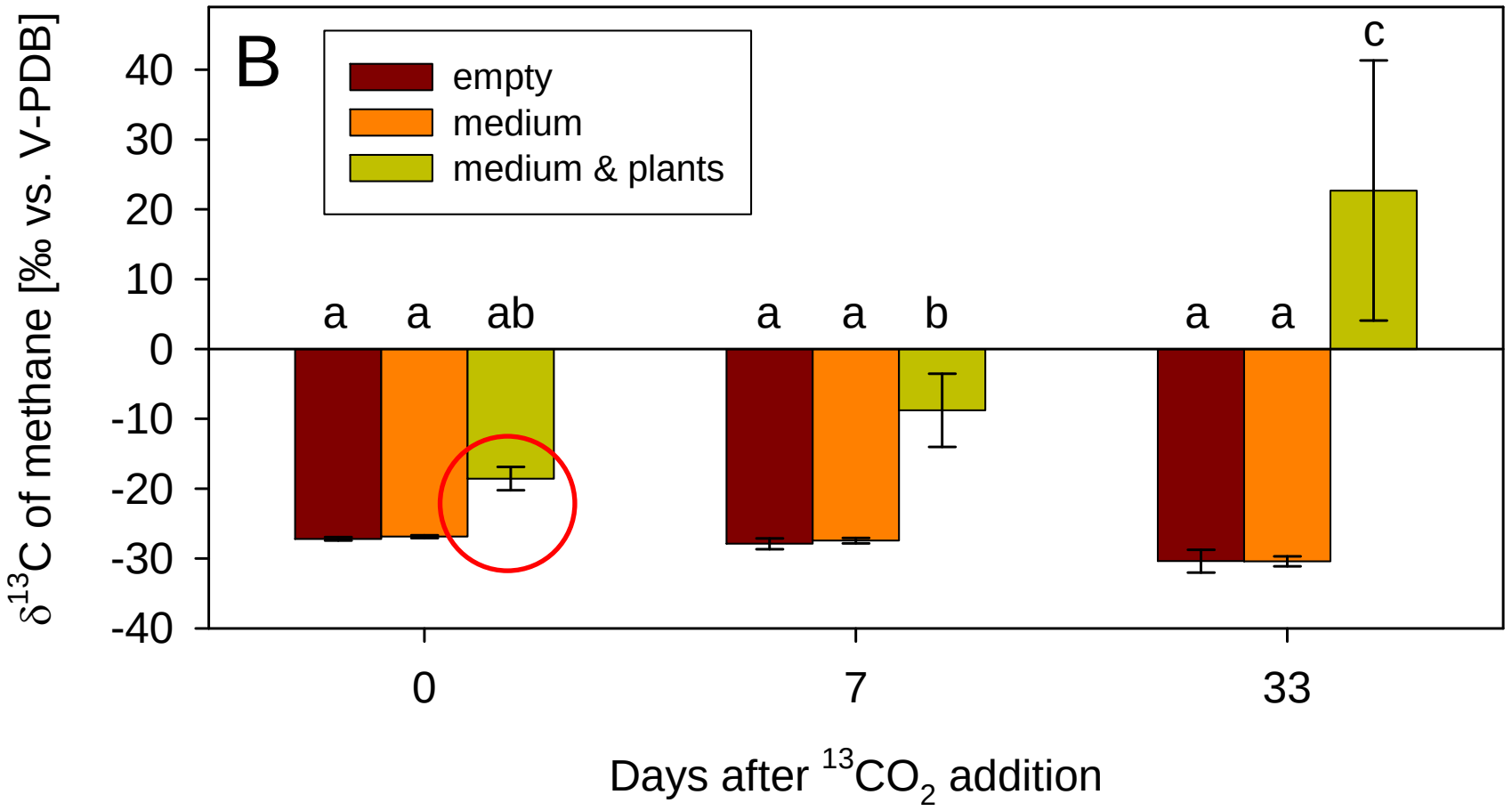
CH_4 formation



CH_4 release rate from plants (mean, ± SE)

0-7 days: 0.55±0.39 ng g^{-1} dw h^{-1}
7-33 days: 0.21±0.11 ng g^{-1} dw h^{-1}
0-33 days: 0.25±0.07 ng g^{-1} dw h^{-1}

$\delta^{13}C$ of CH_4



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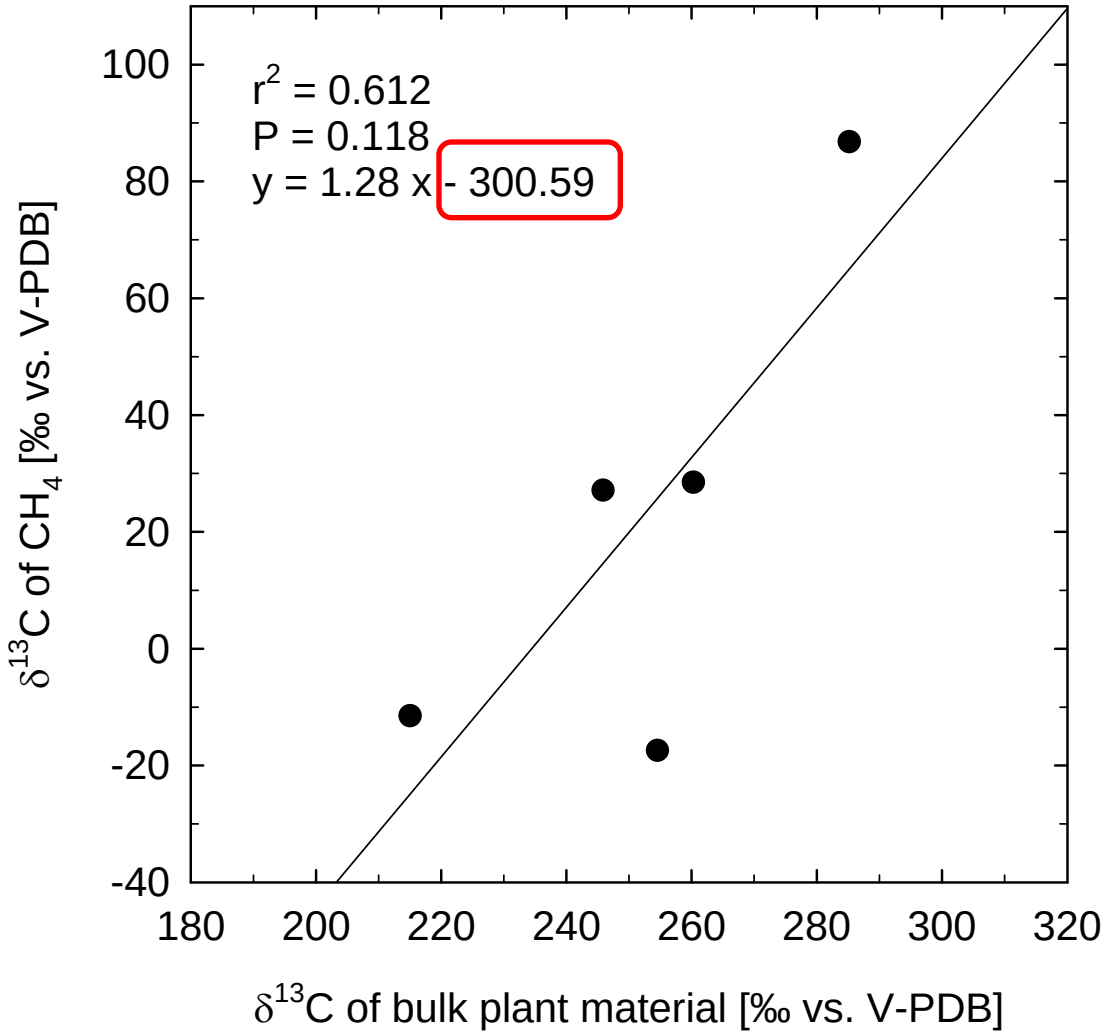
Relationship between $\delta^{13}C$-CH_4 and $\delta^{13}C$ of bulk plant material



Summary

- Keppler et al. (2006) reported on substantial aerobic CH_4 emission from plants and calculated a contribution of 10-30% of this new source to the global methane budget
- So far, other research groups failed to detect aerobic methane emission from plants significantly different from zero
- We have observed CH_4 release from poplar significantly different from zero and isotopically labelled
- However, the observed emission was 3 orders of magnitude lower as reported by Keppler et al. (2006)
- Possible other reasons for high atmospheric methane concentrations in the tropics: anaerobic methane formation in the soil, transport of CH_4 via the transpiration stream and release through the leaves